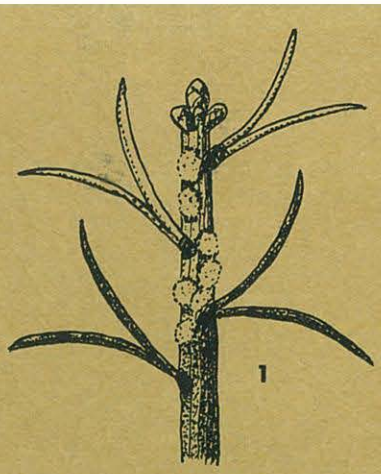
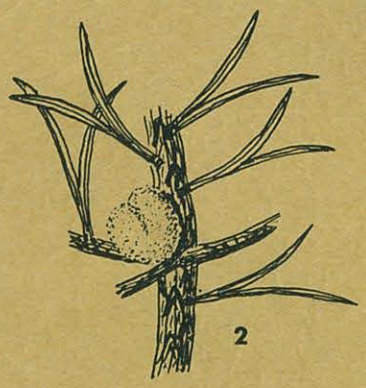
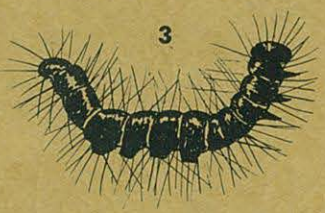




MICHIGAN

FOREST PEST DETECTION PROGRAM

REPORT FOR 1960



COMPILED BY:

FORESTRY DIVISION, MICHIGAN DEPARTMENT OF CONSERVATION

COOPERATORS:

STATE DEPARTMENT OF AGRICULTURE, U. S. FOREST SERVICE, MICHIGAN STATE UNIVERSITY, UNIVERSITY OF MICHIGAN, PRIVATE FOREST INDUSTRY

TABLE OF CONTENTS

	Page
Introduction	ii
Organization of Program	1
Program Activities	2
Cooperators Reports	3
Observation Reports	4
Critical Insects	4
Other Important Insects	18
Diseases	25
Other Conditions	27
Summary	30

COVER: Illustrations on cover depict insects common in the forest but of minor importance.

1. Pine pitch midge
2. Pitch blister moth
3. Walnut caterpillar
4. Bagworm
5. Fall cankerworm
6. Eastern tent caterpillar
7. Rose chafer
8. Eastern spruce gall aphid

INTRODUCTION

The Michigan Forest Pest Detection Program functions through the cooperation of many individuals, public agencies and private companies. Greatly increased interest in the problems of forest insects and diseases in the past few years, coupled with a reasonable and coordinated approach, have kept the program moving forward on an even keel to a point where it is making an increasingly valuable contribution to the welfare of the forests of the state.

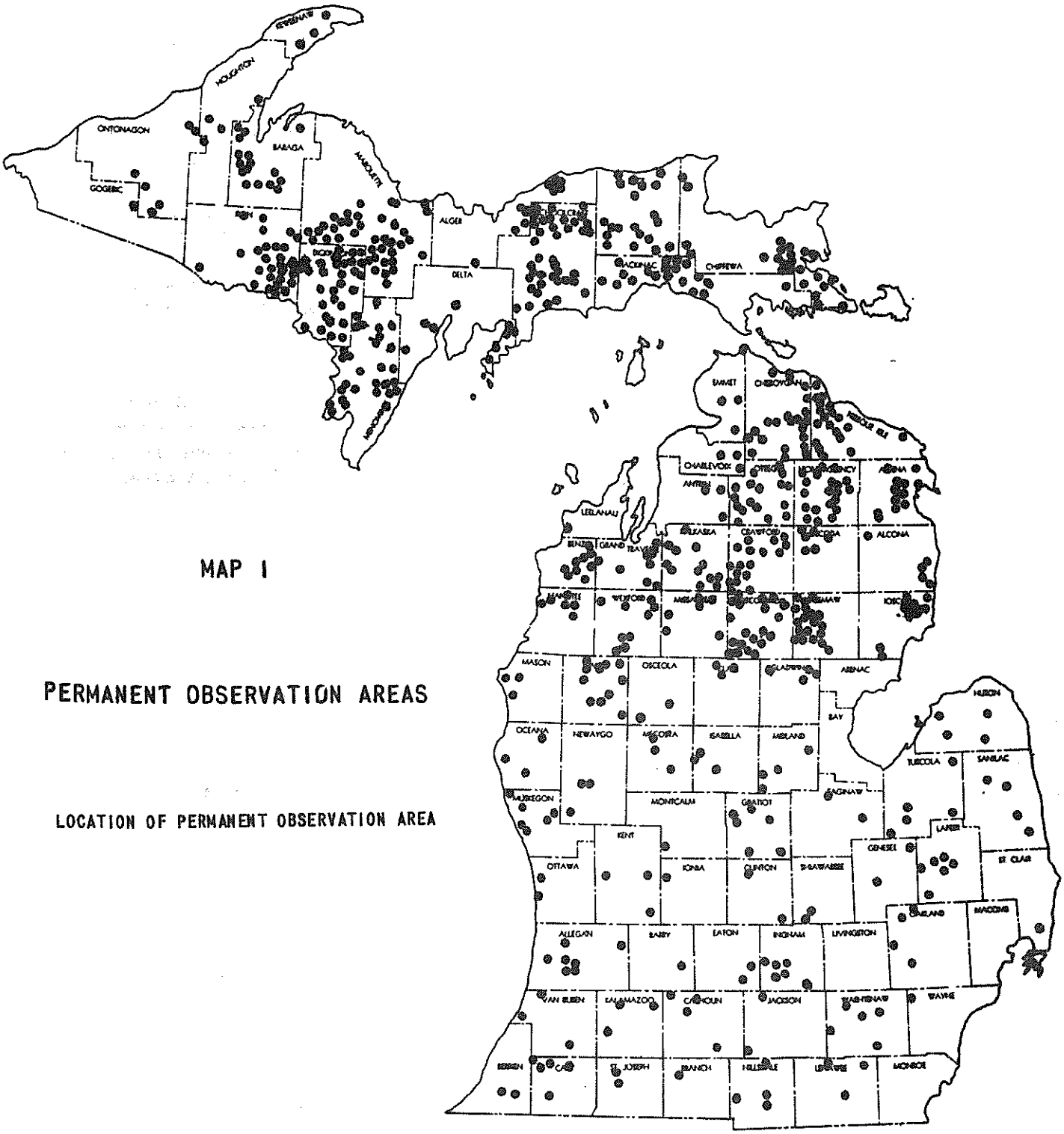
Cooperation with neighboring states in regional activities is an important part of the program. The Tenth Annual Lakes States Forest Insect Survey Conference was held in Madison, Wisconsin, in February, with representatives of federal, state and private agencies participating. The major problem confronting this group is the standardization and coordination of survey techniques and activities in Minnesota, Wisconsin and Michigan. To this end, standardized survey techniques have been approved for the spruce budworm, larch sawfly, forest tent caterpillar, Saratoga spittlebug, jack pine budworm, pine tortoise scale, red-headed pine sawfly, white pine weevil, and balsam gall midge.

On December 14 the annual meeting of the Michigan Forest Pest Detection Program Committee was held in Lansing to review the work carried on during the year by the various agencies concerned with surveys, control and research; to discuss the annual report; and to make plans for 1961. Those in attendance were:

S. D. Adams, U.S.F.S. Regional Office
L. E. Bell, Forestry Department, M.S.U.
W. S. Cath, Michigan Department of Agriculture
J. B. Cody, Private Industry
P. R. Flink, Michigan Department of Conservation
S. A. Graham, School of Natural Resources, U. of M.
F. B. Knight, School of Natural Resources, U. of M.
M. K. Lauritsen, U.S.F.S., National Forests
J. W. Leonard, Michigan Department of Conservation
G. S. McIntire, Michigan Department of Conservation
W. E. Miller, U.S.F.S., Lower Peninsula Research Center
A. F. Monroe, Soil Conservation Service
L. H. Moore, U.S.F.S. Regional Office
L. E. Nelson, U.S.F.S., Blister Rust Control
W. R. Ringe, U.S.D.A., Plant Pest Control Division
V. J. Rudoulph, Forestry Department, M.S.U.
D. C. Schmiege, U.S.F.S., Lake States For. Exp. Sta.
N. F. Smith, Michigan Department of Conservation
F. C. Strong, Botany and Plant Pathology Dept., M.S.U.
R. L. Talerico, U.S.F.S., Lower Peninsula Research Center
R. M. Wilson, Soil Conservation Service
W. J. Young, Michigan Department of Agriculture

Information on the pest conditions on federal lands was obtained in part from the Lake States Forest Experiment Station report on "The More Important Forest Insects in the Lake States in 1959", and the U. S. Forest Service report, "Annual Regional Report on Forest Insects and Disease Conditions - Region 9."

* * *



MAP 1

PERMANENT OBSERVATION AREAS

LOCATION OF PERMANENT OBSERVATION AREA

ORGANIZATION OF PROGRAM

Increasing awareness and concern about losses caused by insects and diseases to the forests of Michigan led to the beginning of a forest pest detection program in 1950. The program was outlined and organized by the Conservation Department with the cooperation of the U. S. Bureau of Entomology and Plant Quarantine (now the Division of Forest Insect Research, U. S. Forest Service), the U. S. Forest Service; the School of Natural Resources, University of Michigan; the Departments of Entomology, and Botany and Plant Pathology, and Forestry Extension Service, Michigan State University; the Division of Plant Industry, State Department of Agriculture.

The program involves more than the mere detection of forest pest outbreaks, its objectives being: (1) to detect the presence of forest insects and diseases, and to apprehend outbreaks by systematically and annually collecting records of occurrence and damage; (2) to facilitate and organize direct control in case of emergency; and (3) to provide a basis for protective measures by indirect means.

The detection framework is built principally around the field organization of the Forestry Division of the Conservation Department, which handles state and private lands and the U. S. Forest Service which handles federal lands. The general field plan for insects insofar as the State Forestry Division districts are concerned, calls for the establishment of permanent observation areas scattered throughout each forest district on both state and private lands in timber stands where critical insects exist or are likely to appear. (See Map I.) Observation reports are submitted annually to the Lansing office of the division, indicating the degree of infestation, or the absence, of each of the critical insects on the designated plots. Those critical insects found only in the southern part of the state are not reported on in the northern regions, and vice versa. Thus, each district forester has only six to eight critical insects to observe.

The two educational institutions participate in training programs and act in an advisory capacity on insect and disease identification and control measures, as does also the Division of Forest Insect Research of the U. S. Forest Service.

The State Department of Agriculture, through its Division of Plant Industry, is directly concerned in the program by virtue of its statutory authority to establish quarantines, to enter on private lands for purposes of inspection, and, where necessary, to compel or provide for the control of serious insect pests and contagious plant diseases.

The disease phase of the program does not follow the same routine as applied to insects, since there are relatively few "critical" forest diseases requiring constant surveillance. Individual programs have been developed for the most important diseases with various state and federal agencies cooperating in survey and control work.

* * *

PROGRAM ACTIVITIES

INFORMATION RELEASES

Although no new pest information leaflets were issued in 1960 to add to the 20 issued from 1956 to 1958, many requests continued to be received from cooperators, land owners, teachers and others for the separate leaflets and for "Michigan Forest Pests", which is the compilation of the separate leaflets.

Two identification sheets were printed for use in training sessions and for distribution as needed. The first sheet covered the larvae of the seven most common pine sawflies in Michigan, and the second sheet included four shoot and tip feeding insects: the white pine weevil, European pine shoot moth, Zimmerman pine moth, and Rhyacionia adana.

Several special reports, in the form of general memorandums, were issued throughout the year whenever it was advisable to alert the cooperators to unusual conditions, new pests in their areas, time for control application or other important information.

Suggested news releases were sent to the Department foresters for their use, saving them the time required to write such articles. The purpose of these news releases was to alert landowners to the potential pests, recommended control measures, and correct timing for spray application.

TRAINING SESSIONS

Training sessions on the important forest insects were held for the Conservation Department district foresters in conjunction with the divisional meeting in March. A training session for U. S. Forest Service personnel was participated in during April. Programs on the identification and control of tree pests were presented at three Christmas tree growers' meetings.

COOPERATIVE REPORTS

The Michigan forest pest detection program helps to provide information for other cooperative reports as follows:

Lake States Forest Pest News Letter - A forest pest news letter covering the current status of the important forest pests in the Lake States was initiated in 1960 by the Lake States Forest Experiment Station at St. Paul, Minnesota. The purpose of the news letter is to enable entomologists, foresters, and others concerned, to keep abreast of the current pest situation. Three issues were published in 1960 on June 30, August 24, and October 26. The information in the news letter is submitted to the Lake States Forest Experiment Station by foresters and entomologists from federal, state, and private agencies throughout the Lake States. A summary of the current situation in Michigan, from information gained through the Michigan forest pest detection program reports and surveys, is submitted for use in each issue.

Cooperative Economic Insect Report - Information on insect infestations and seasonal development is sent to Professor Ray Hutson, Department of Entomology, Michigan State University, who forwards it to the Plant Pest Control Division, Agricultural Service, U. S. Department of Agriculture, for inclusion in the Cooperative Economic Insect Report. This report is a weekly resumé of important insects in the United States and includes a section on forest insects.

The Forest Insect and Disease Situation in the Lake States - Annually the forest pest situation in the Lake States is summarized by the Lake States Forest Experiment Station from information submitted by the states and also collected by the Station. The forest insect situation in Michigan as reported in the annual report of the Pest Detection Program is forwarded to the Station for inclusion in the Lake States report.

A Status Report of Forest Insect Conditions - The information compiled in the previously mentioned report by the Lake States Forest Experiment Station is included in the Status Report of Forest Insect Conditions covering the United States and published annually by the Division of Forest Insect Research, Forest Service, U. S. Department of Agriculture in Washington, D.C.

* * *

COOPERATORS REPORTS

Cooperators aid in the detection program by reporting on insect conditions in areas not covered by state foresters, thus helping to present a better overall picture of the forest insect situation in the state.

The following cooperators submitted reports on observations during 1960:

American Box Board Company
Oliver Iron Mining Division, U. S. Steel Corporation
Division of Plant Industry, Michigan Department of Agriculture
U. S. Forest Service
Michigan State University

* * *

OBSERVATION REPORTS

A total of 1,749 observation reports was received and analyzed by the Lansing office of the Forestry Division. This represents a decrease of 180 reports from those received in 1959. The decrease is due primarily to dropping of the anomala beetle from the critical insects reported on in the Upper Peninsula, and a decrease in reports by industrial foresters. In addition to the regular observation reports, letters and cards were received with observations on other forest insect conditions.

The total number of permanent observation areas is now 694, an increase of four from 1959. (See Map I)

* * *

CRITICAL INSECTS

The list of critical forest insects in Michigan has been changed from time to time to include actively or potentially injurious insects and to remove from the list those which are no longer considered thus.

At the December 1959 meeting of the Pest Detection Program Committee, it was decided to eliminate the anomala beetle from the insects reported on in the Upper Peninsula. This pest has not yet been found in that area.

Following are reports of critical insects for 1960:

JACK PINE BUDWORM - *Choristoneura pinus* Free.

Jack pine budworm populations remained at a low level for the third year in Lower Michigan while greatly increased defoliation appeared in several areas in the Upper Peninsula. (See Map II). On state land the areas of heavy defoliation were on the Baraga plains in western Baraga County and in central Marquette County north of Gwinn. The extent of these infestations is not known but plans are being made to make an aerial survey in 1961.

Widespread infestations were reported on the Sault Ste. Marie, Manistique and Munising ranger districts of the Upper Michigan National Forest. The U. S. Forest Service expects that control measures may be necessary on the Ottawa and Upper Michigan National Forest unless it shows signs of declining.

In the past in Michigan the budworm has defoliated stands for two or three years and then disappeared, causing little damage to the trees with the exception of growth loss and some reproduction mortality.

JACK PINE BUDWORM (Cont'd.)

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	135	185	232	280	291	276	267	269	246	244
Percent Positive..	38	40	32	20	20	29	22	19	14	11

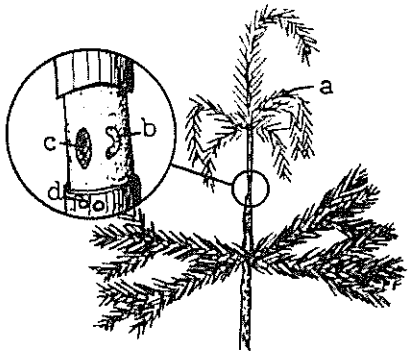
Breakdown of 1960 Reports

Heavy defoliation (61-100%).....0.....(0%)
Medium defoliation (21-60%).....1.....(4%)
Light defoliation (1-20%).....26.....(96%)

WHITE PINE WEEVIL - Pissodes strobi (Peck)

Infestations of the white pine weevil continue at a high level. Weeviling of over 60 percent was reported in some of the jack and white pine plantations in Marquette, Schoolcraft, and Chippewa counties in the Upper Peninsula, and Cheboygan, Otsego, Grand Traverse, Manistee, Mecosta, Midland, Muskegon, Gratiot, Saginaw, Tuscola, Kent and Allegan counties in Lower Michigan. Weevil damage can be found almost everywhere in the state where its hosts are found, although the heaviest concentration of damage is in northern Lower Michigan. (See Map III)

Larva: White
Under bark
mid-May to
late August



Injury Characteristics:

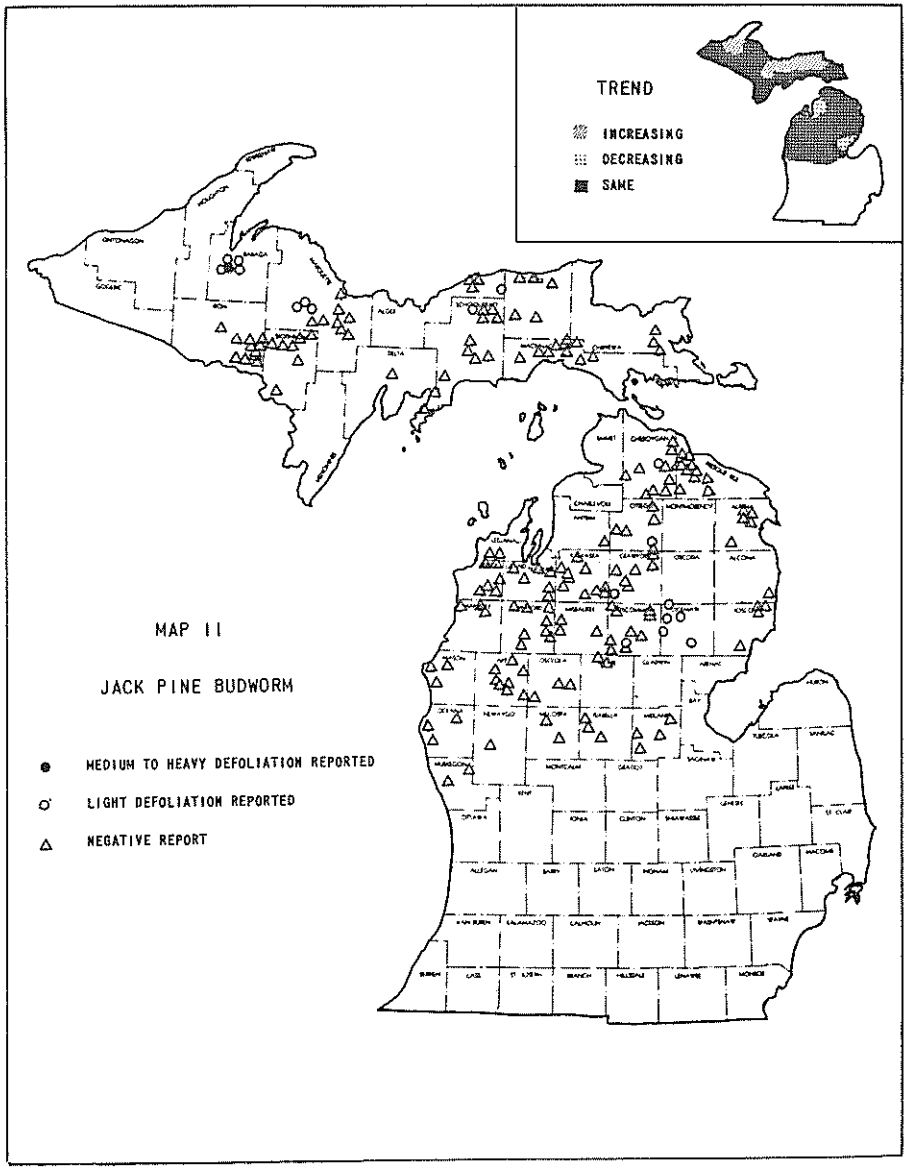
Only attacks leaders

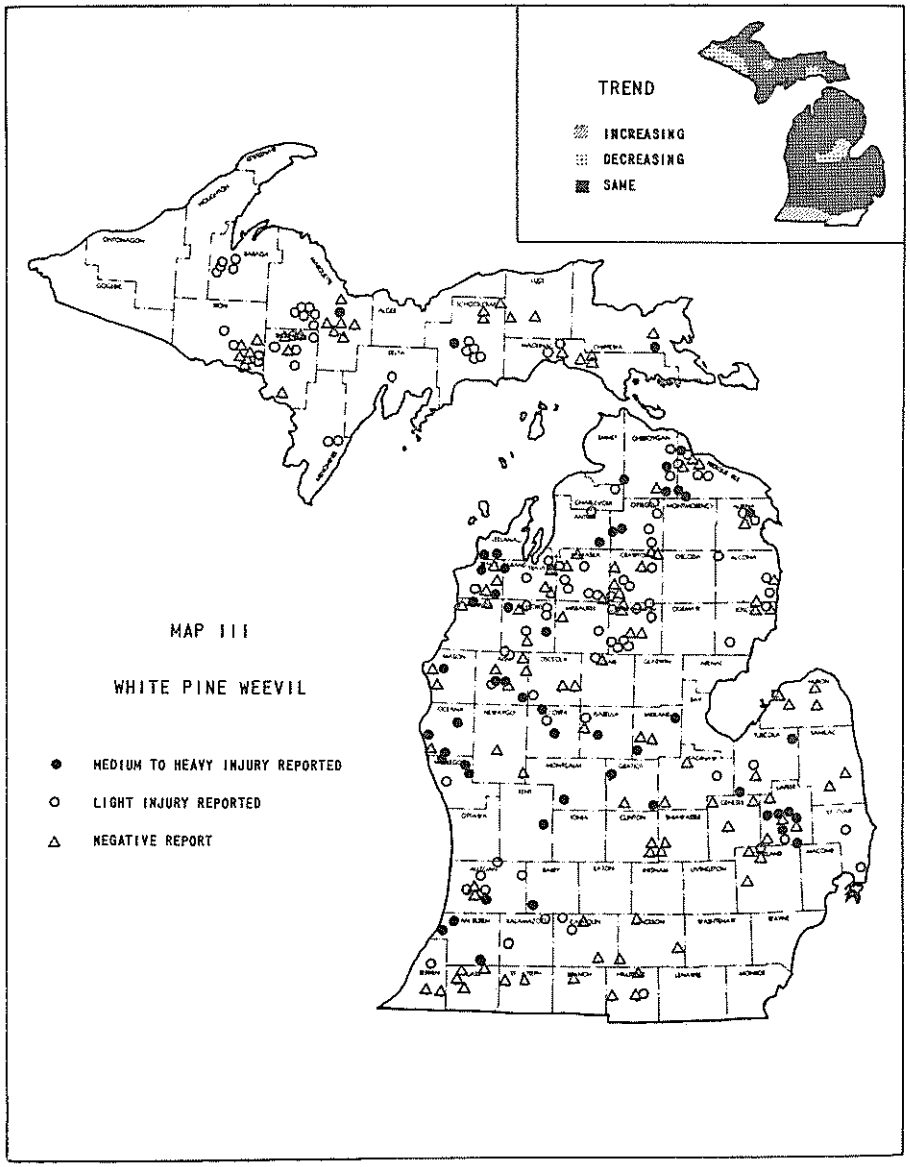
a. Wilted new growth
b. Larvae under bark
c. Pupal chamber cut in wood
d. Small round emergence holes in bark after adults leave

The weevil continues to be absent from the extreme southeastern counties in Lower Michigan. It was reported in Oakland County for the first time in 1960.

It is expected that the weevil will remain at the high damaging level of infestation in 1961.

Surveys and Control - In 1960, 160 acres of jack pine plantations were hand sprayed by inmate labor using DDT. Thirty-six acres of the 160 acres had the misshapen and forked trees clipped before they were sprayed. The object of the clipping was to restore the trees to a single stemmed tree. In some plantations this was necessary as the multiple leadered trees were not adequately covered during the spraying with the insecticide. Adjacent, unsprayed plantations or unsprayed portions of the sprayed


TREND
INCREASING
DECREASING
SAME
MAP II
JACK PINE BUDWORM
MEDIUM TO HEAVY DEFOLIATION REPORTED
LIGHT DEFOLIATION REPORTED
NEGATIVE REPORT


TREND
INCREASING
DECREASING
SAME
MAP III
WHITE PINE WEEVIL
MEDIUM TO HEAVY INJURY REPORTED
LIGHT INJURY REPORTED
NEGATIVE REPORT

WHITE PINE WEEVIL - (Cont'd.)

plantations had 30 percent of the trees weeviled while the sprayed areas had only .7 percent weeviled.

During late summer, the weeviled jack pine tops on 105 acres were clipped and burned by inmate crews. This method is used to reduce the population present for attacking the trees the following year. It does not prevent damage during the year of clipping and does not completely eliminate the infestation as some infested tops are missed and the weevils survive.

Funds are available for the purchase of additional spraying equipment for the inmate crews and it is anticipated that the spraying program will be increased in 1961.

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	39	33	231	278	319	306	317	335	333	306
Percent Positive..	82	64	65	59	60	53	56	62	58	62

Breakdown of 1960 Reports

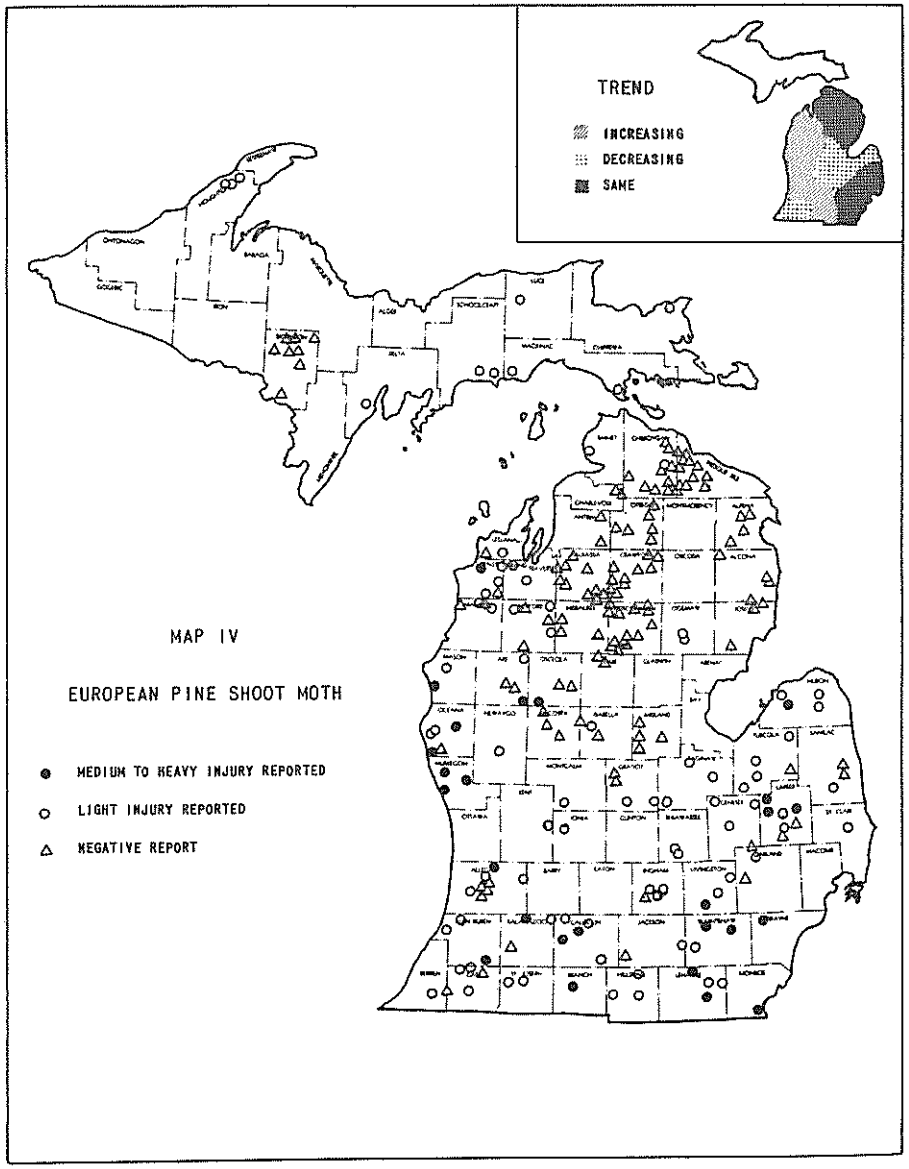
Heavy injury (41-100% of leaders killed).....19.....(10%)
Medium injury (11-40% of leaders killed).....48.....(25%)
Light injury (1-10% of leaders killed).....122.....(65%)

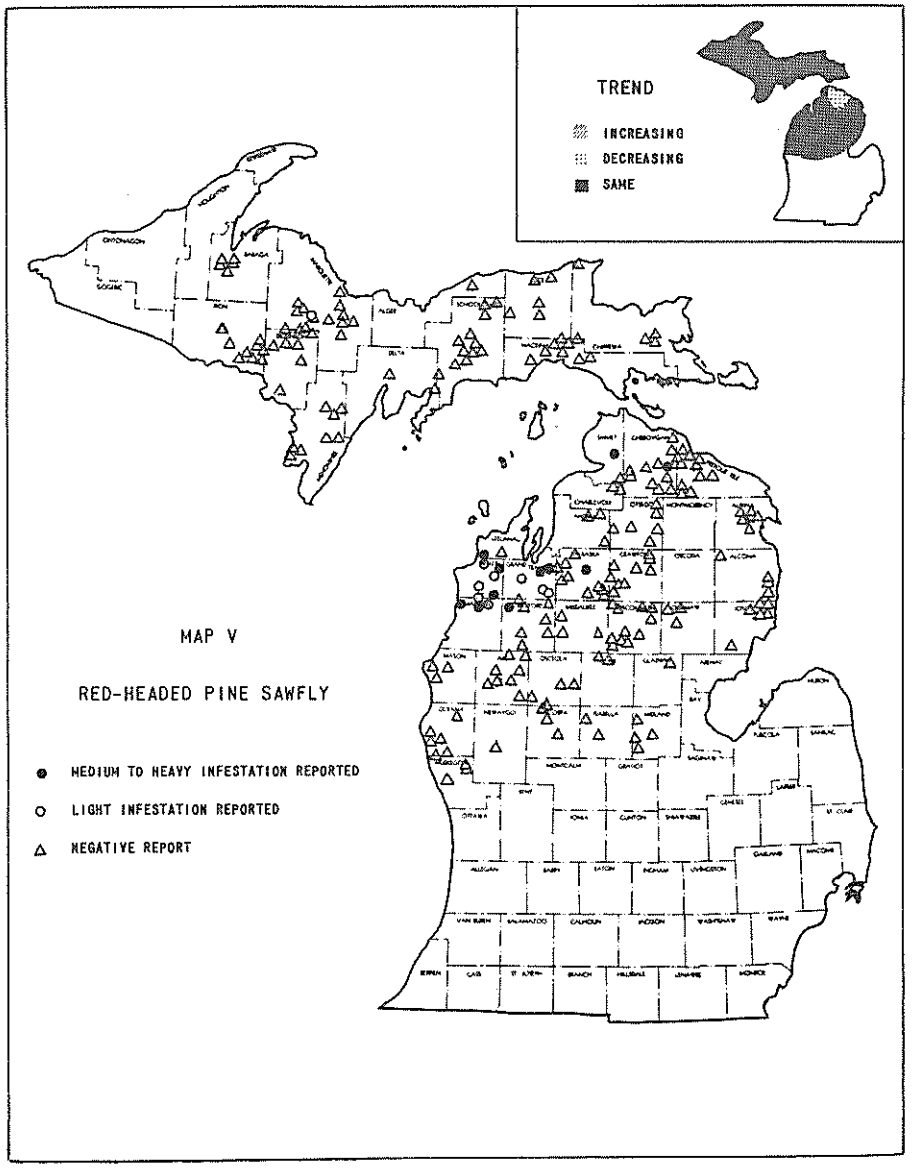
EUROPEAN PINE SHOOT MOTH - Rhyacionia bouliana (Schiff.)

A general decline in European pine shoot moth damage was noted in 1958 and 1959 over most of its range in Michigan. This lowered level of damage continued in 1960. Many of the previously heavily injured plantations have reached a size where they are able to outgrow much of the damage. Plantations once considered practically worthless now show promise of developing into merchantable trees even though they have not been sprayed.

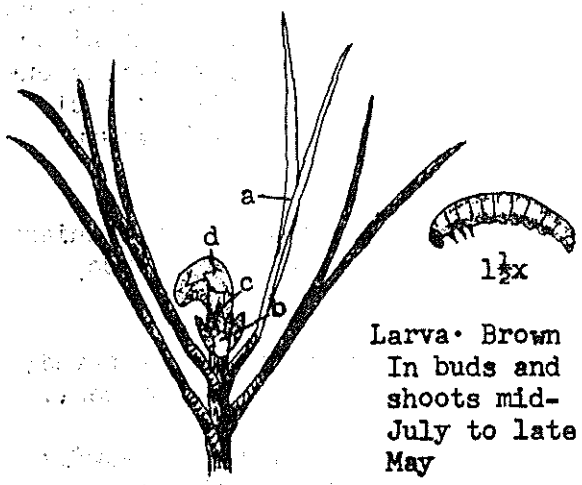
An area of infestation in Escanaba in the Upper Peninsula was first reported in 1957 but due to an oversight has not been previously recorded in this report. Otherwise, the shoot moth is probably present in all of the counties in Lower Michigan and is known to be present in Delta, Chippewa, Mackinac, Luce, Schoolcraft, and Houghton counties in the Upper Peninsula. (See Map IV)

At present, there has not been a control method developed that is economical and practical to use for widespread application to forest plantations, and therefore the shoot moth will continue to be a serious pest of red and Scotch pines. Much of the damage to forest plantations can be lessened, however, by planting pine on the better sites where they will grow past the most susceptible stage in the shortest time.


TREND
INCREASING
DECREASING
SAME
MAP IV
EUROPEAN PINE SHOOT MOTH
MEDIUM TO HEAVY INJURY REPORTED
LIGHT INJURY REPORTED
NEGATIVE REPORT


TREND
INCREASING
DECREASING
SAME
MAP V
RED-HEADED PINE SAWFLY
MEDIUM TO HEAVY INFESTATION REPORTED
LIGHT INFESTATION REPORTED
NEGATIVE REPORT

EUROPEAN PINE SHOOT MOTH - (Cont'd.)



Larva· Brown In buds and shoots mid-July to late May

Injury Characteristics:

a. Dead needles near tip
b. Pitch globules between buds
c. Dead buds
d. Dead shoots

Control - A samll control program was carried out on the Fife Lake State Forest. In late May and early June, while the shoot moth larvae or pupae were still in the damaged shoots, the shoots were clipped and burned. In Grand Traverse County 48 acres were treated, and in Wexford County 27 acres were treated.

In late June 87 acres in Wexford County and 36 acres in Benzie County were sprayed with DDT to kill the newly hatching larvae. Inmate labor with back pack sprayers were used to apply the insecticide.

A DDT spray program to eliminate the shoot moth in the Conservation Department nurseries was effective with the exception of a few beds in one nursery. The red pine transplants in these beds were fumigated with methyl bromide before they were shipped from the nursery.

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	44	80	119*	203	207	258	242	229	225	238
Percent Positive..	80	40	47	39	49	42	48	51	52	44

*Increase due to inclusion of insect on critical list of districts in northern half of Lower Peninsula.

Breakdown of 1960 Reports

Heavy injury*.....22.....(21%)
Medium injury*.....5.....(5%)
Light injury*.....78.....(74%)

*Degree of injury = "I" =

$$\frac{\% \text{ of susceptible trees attacked} \times \% \text{ of tips infested}}{100}$$

Heavy if "I" is greater than 20
Medium if "I" is between 10 and 20
Light if "I" is less than 10

RED-HEADED PINE SAWFLY - Neodiprion lecontei (Fitch)

A sharp decline of the red-headed pine sawfly was noted in the northeastern section of Lower Michigan, particularly on the Black Lake and Thunder Bay River state forests. Both of these forests had light infestations in many plantations in 1959. It was expected that these would increase the necessity for control measures in 1960, but this did not happen. The sawfly was practically absent throughout most of this area.

Sawfly populations continued at a high level in northwestern Lower Michigan, particularly in Kalkaska, western Cheboygan, Emmet, Wexford, Grand Traverse, Benzie, Leelanau, Manistee and Missaukee counties. (See Map V)

In the Upper Peninsula occasional occurrences of the sawfly were reported; however, there was little of sufficient magnitude to be of concern at present.

In general, with the exception of northwestern Lower Michigan, the sawfly populations were less than in 1959 and were expected to continue that way.

Surveys and Control - Based on information on sawfly occurrence and abundance gained through the 1959 Pest Detection Program, it was decided to inspect most of the plantations established between 1949 and 1956 on the Fife Lake State Forest; and the plantations on the Au Sable, Hardwood, Pigeon River, Houghton Lake, Black Lake and Thunder Bay River state forests where sawflies had been found in 1959. A total of 536 forties were checked for damaging sawfly populations. Of the plantations checked, 91 forties contained infestations of sufficient size to warrant control operations. The need for control is based on the number of sawfly colonies per tree, percent of trees infested, and the size and health of the trees.

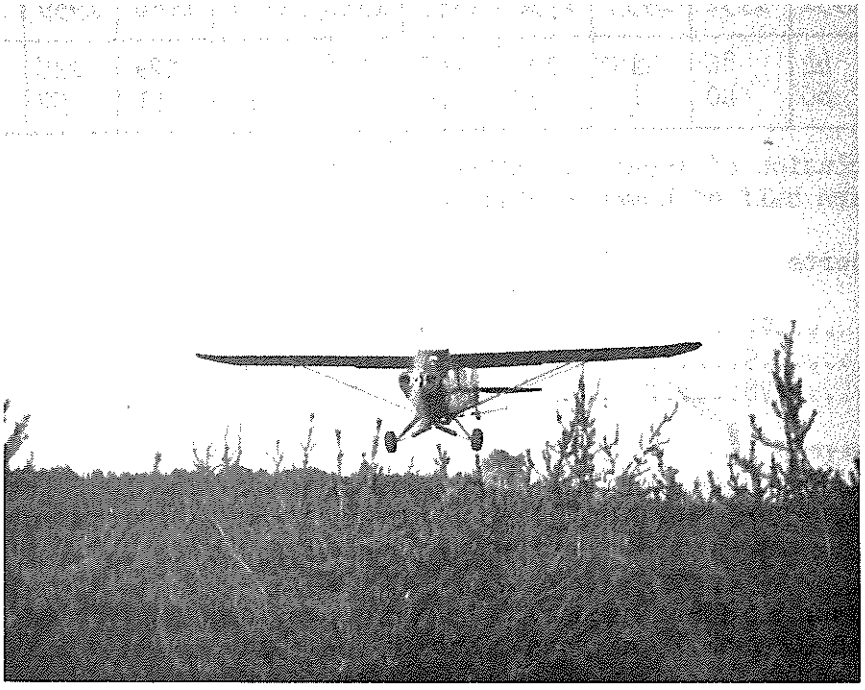


Figure 1.

Airplane spraying DDT to control red-headed pine sawfly larvae.

RED-HEADED PINE SAWFLY (Cont'd.)

In July 3,129 acres, of which 2,418 acres were red and jack pine plantations, were aerially sprayed with one pound of DDT in one gallon of oil per acre. The average cost was $1.37 per acre sprayed, or $1.77 per acre of actual pine plantation. Included in the total area sprayed are buffer strips around the edge of the plantations, and roads, clumps of hardwoods, etc. in the plantations.

The following acreages were treated:

Fife Lake State Forest	Wexford County	518 Acres
	Manistee County	427 Acres
	Grand Traverse County	87 Acres
	Benzie County	154 Acres
	Leelanau County	268 Acres
Au Sable State Forest	Kalkaska County	523 Acres
Hardwood State Forest	Emmett County	276 Acres
Houghton Lake State Forest	Missaukee County	59 Acres
Pigeon River State Forest	Otsego County	25 Acres
Mackinac State Forest	Mackinac County	81 Acres
Total		2,418 Acres

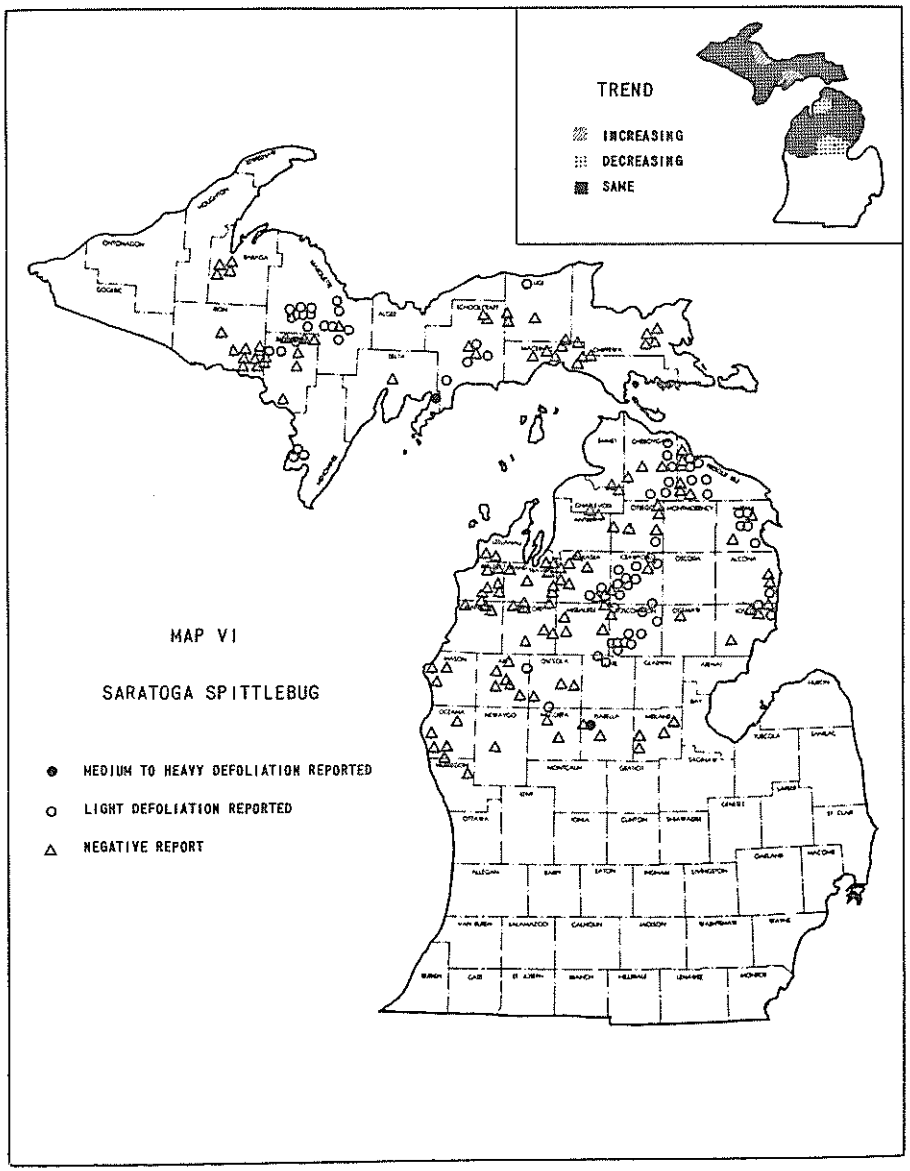
Control results were excellent in almost all areas checked after the spraying. The one exception was a plantation sprayed when no observer was present on the ground to help guide the plane.

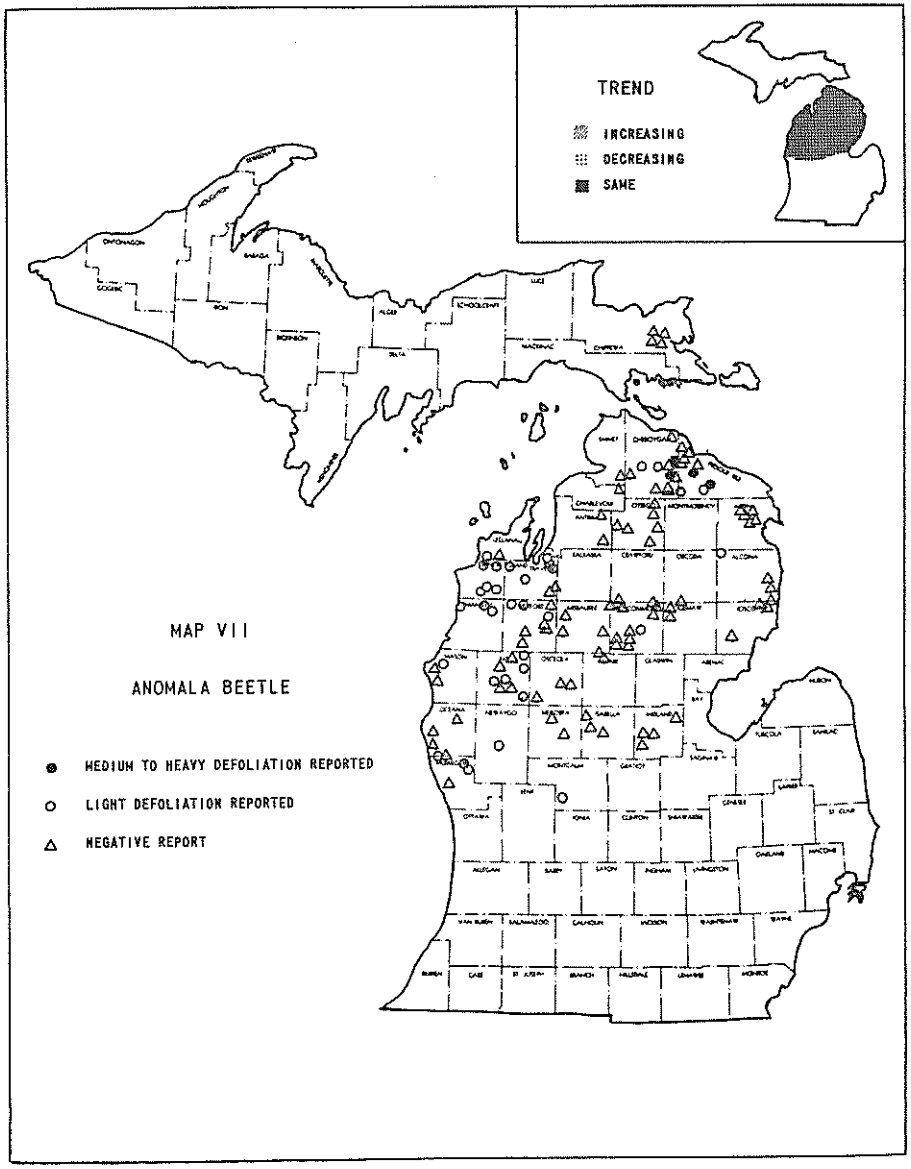
Conservation Department Game Division biologists checked the song bird populations on some of the areas before and after spraying. No dead or sick birds or animals were found nor was any change in wildlife activity apparent. Several of the plots actually showed an increase in song birds, probably due to survey methods.

In addition to the aerial spraying, 29 acres were sprayed by inmate labor using back-pack pumps on the Fife Lake State Forest.

The U. S. Forest Service aerially sprayed 88 acres on the Rapid River District of the Upper Michigan National Forest to control the sawfly.

It is anticipated that some control work will have to be done on the Fife Lake, Hardwood and Au Sable state forests in 1961 and will have to be continued until the present outbreak subsides.


TREND
INCREASING
DECREASING
SAME
MAP VI
SARATOGA SPITTLEBUG
MEDIUM TO HEAVY DEFOLIATION REPORTED
LIGHT DEFOLIATION REPORTED
NEGATIVE REPORT


TREND
INCREASING
DECREASING
SAME
MAP VII
ANOMALA BEETLE
MEDIUM TO HEAVY DEFOLIATION REPORTED
LIGHT DEFOLIATION REPORTED
NEGATIVE REPORT

RED-HEADED PINE SAWFLY (Cont'd.)

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	133	173	231	230	260	255	239	249	233	248
Percent Positive..	18	7	8	8	5	5	16	14	18	9

Breakdown of 1960 Reports

Heavy defoliation (11-100% susceptible trees attacked).....1.....(4%)
Medium defoliation (2-10% susceptible trees attacked).....10.....(44%)
Light defoliation (0-1% susceptible trees attacked).....12.....(52%)

SARATOGA SPITTLEBUG - Aphrophora saratogensis (Fitch)

Damage due to the Saratoga spittlebug was less in 1960 than it had been in 1959. This reflected the lower populations present in 1959, as the damage does not show up until the fall or spring following the feeding. Reports of medium damage were received from Delta County in the Upper Peninsula and Isabella County in Lower Michigan. In 1960 the weather was more favorable and increased numbers of spittlebugs were present, particularly in the western end of the Upper Peninsula. (See Map VI)

Surveys and Control - There were no special surveys or control for the Saratoga spittlebug on state land in 1960. However, during the red-headed pine sawfly survey, a record was kept of those plantations where sweet fern was abundant and were therefore potential high spittlebug hazard areas. These will be watched for signs of spittlebug increases.

The U. S. Forest Service aerially sprayed 709 acres on the Upper Michigan National Forests. It is expected that at least a similar acreage will require treatment in 1961.

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	17	51	164	211	229	225	214	240	221	227
Percent Positive..	88	27	34	23	28	27	30	32	42	34

Breakdown of 1960 Reports

Heavy injury (61-100%).....0.....(0%)
Medium injury (21-60%).....2.....(3%)
Light injury (1-20%).....76.....(97%)

ANOMALA BEETLE or PINE CHAFER - Anomala oblivia Horn

The overall populations of the anomala beetle continue to remain at a low level, as they have since 1958. In localized spots, however, in north central and northwestern Lower Michigan, heavy defoliation of jack pine has occurred. The fewer needles per branch of jack pine as compared to red pine enable a smaller number of insects to cause more obvious defoliation of jack pine. (See Map VII)

Complete defoliation does not occur, as a stub of the needle usually remains on the branches, providing the tree with some chlorophyll producing needle surface.

Christmas tree growers conduct a control program against this pest where it is abundant. At the present time, control measures in forest plantations have not been carried on because growth loss only has occurred, not mortality or deformity of the trees.

The anomala beetle is not known to be present in the Upper Peninsula or the southern third of Lower Michigan. This year it was dropped from the list of insects reported on in the Upper Peninsula, although casual observations for its presence will still be made.

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	119	181	236	278	275	271	269	243	239	140
Percent Positive..	35	36	32	38	38	37	22	14	14	29*

*The apparent increase in percent of positive reports is due to the dropping of observations for this insect in the Upper Peninsula where it has never been found.

Breakdown of 1960 Reports

Heavy defoliation (61-100%).....1.....(2%)
Medium defoliation (21-60%).....3.....(8%)
Light defoliation (1-20%).....36.....(90%)

LARCH SAWFLY - Pristiphora erichsonii (Htg.)

Larch sawfly defoliation tapered off in some areas in the Upper Peninsula, particularly in the western section. Through most of the rest of its present range, populations varied more than usual. This fluctuation in sawfly population was probably due to drastic changes in water levels. Following a period of moisture deficiency when the cocoons were being spun in the sphagnum under the trees last August, heavy fall and spring rains raised the water level and sustained it at a high level. This undoubtedly caused the drowning of many insects.

In 1959, 60 percent of the positive reports showed heavy defoliation (over

LARCH SAWFLY (Cont'd.)

60 percent defoliation) and 25 percent showed medium defoliation (21 to 60 percent defoliation). In 1960, only 34 percent of the positive reports indicated heavy defoliation and 54 percent indicated medium defoliation. Thus, while the overall area of infestation remained the same, the intensity has generally declined. With normal water levels, rather than the drastic fluctuations of the past year, the intensity can be expected to increase again.

All reports of the larch sawfly were positive in the Upper Peninsula and in Lower Michigan north of Town Line 20, with the exception of one in Benzie County. (See Map VIII)

No control measures have been applied or are contemplated on state land because of the low economic value of larch, occurrence of larch in scattered patches, and the difficulty of controlling this insect by aerial spraying.

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	68	113	137	135	145	140	133	131	118	116
Percent Positive..	0	30*	42	73*	66	81	85	95	97	99

*The apparent increase is largely due to intensified surveys rather than buildup of insect populations.

Breakdown of 1960 Reports

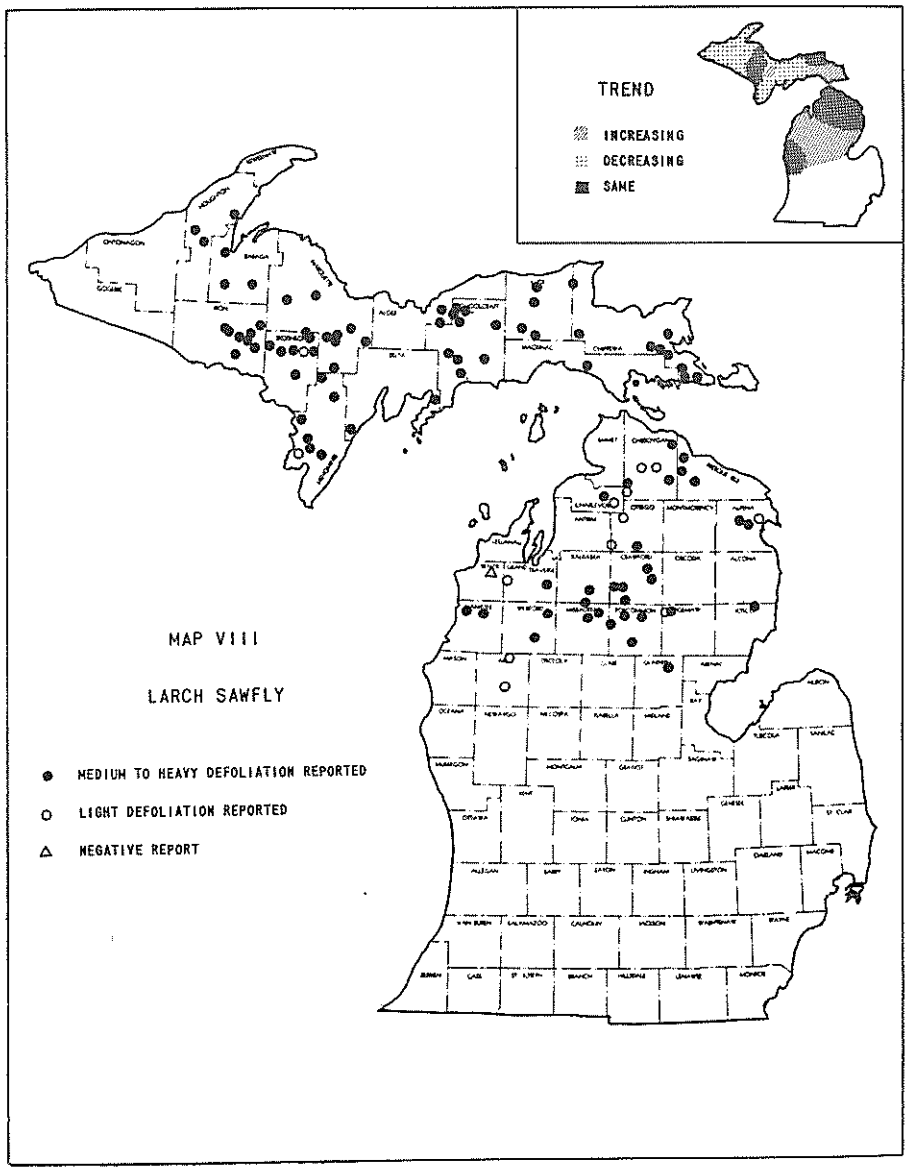
Heavy defoliation (61-100%).....39.....(34%)
Medium defoliation (21-60%).....62.....(54%)
Light defoliation (1-20%).....14.....(12%)

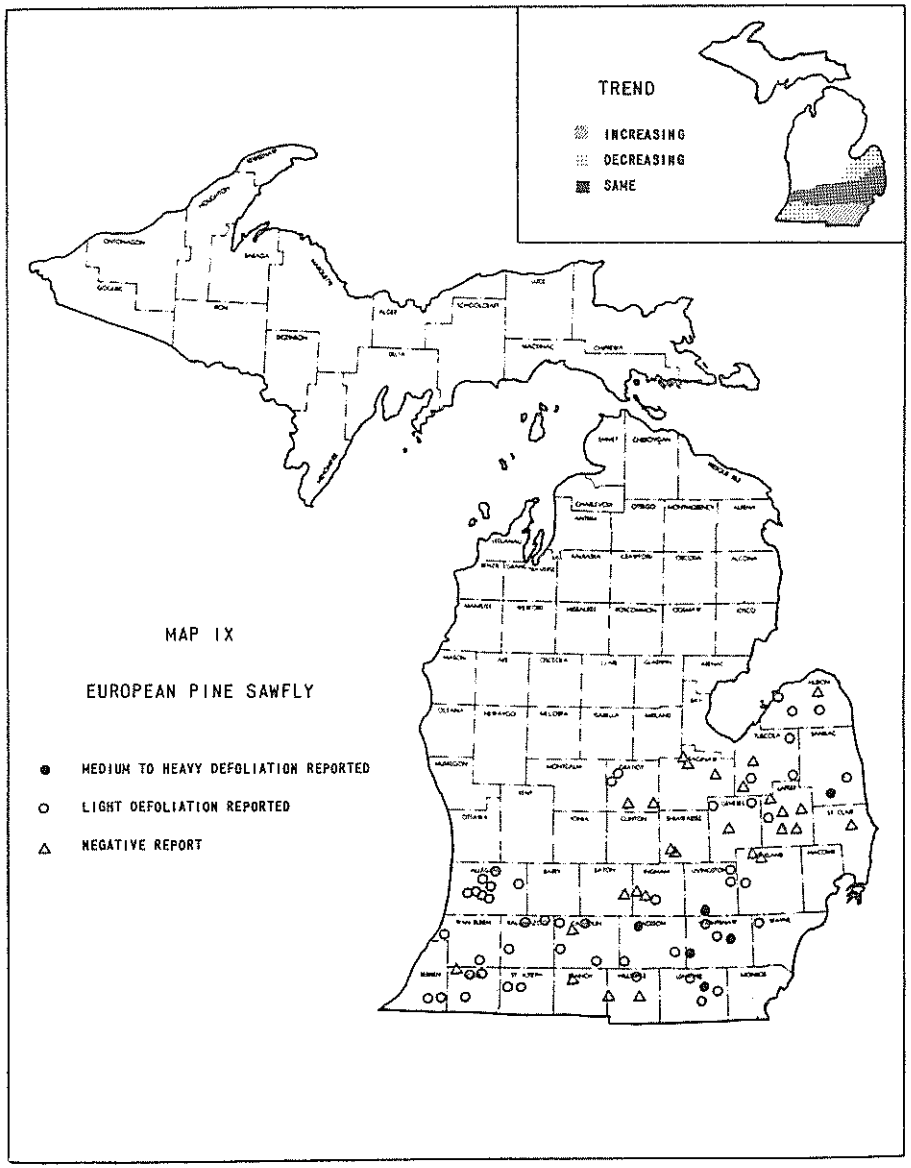
EUROPEAN PINE SAWFLY - Neodiprion sertifer (Geoff.)

The European pine sawfly continues to cause defoliation in some pine stands in the southern part of Lower Michigan. Heavy defoliation was reported from Sanilac, Livingston, Jackson, Washtenaw and Lenawee counties. (See Map IX). The loss of old needles, caused by sawfly defoliation, seriously reduces the value of the trees for Christmas trees. Therefore, many plantations in the intensively managed area of the southern part of Lower Michigan are sprayed to prevent the buildup of damaging populations. In general, forest plantations are not sprayed until several years of heavy defoliation have occurred.

Approximately 25 percent of the observation areas were sprayed during 1959 or 1960, thus obscuring the infestation trends. In general, however, the sawfly is increasing in the southeastern part of its range in Michigan, decreasing in the southwest and northeast portions and remaining the same elsewhere.

Control operations using airplanes, power sprayers, or hand sprayers to apply DDT or other insecticides generally met with success.


TREND
INCREASING
DECREASING
SAME
MAP VIII
LARCH SAWFLY
MEDIUM TO HEAVY DEFOLIATION REPORTED
LIGHT DEFOLIATION REPORTED
NEGATIVE REPORT


TREND
INCREASING
DECREASING
SAME
MAP IX
EUROPEAN PINE SAWFLY
MEDIUM TO HEAVY DEFOLIATION REPORTED
LIGHT DEFOLIATION REPORTED
NEGATIVE REPORT

EUROPEAN PINE SAWFLY (Cont'd.)

Summary of Reports

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Total.....	31	64	85	82	111	100	104	91	97	89
Percent Positive..	87	69	74	75	74	62	56	59	48	57

Breakdown of 1960 Reports

Heavy defoliation* .....6.....(12%)
Medium defoliation*.....0.....(0%)
Light defoliation* .....45.....(88%)

*Degree of defoliation = "D" =

$$\frac{\text{\% of susceptible trees attacked} \times \text{\% of defoliation}}{100}$$

Heavy if "D" is greater than 24
Medium if "D" is between 9 and 24
Light if "D" is less than 9

FOREST TENT CATERPILLAR - Malacosoma disstria Hbn.

A few clusters of larvae of the forest tent caterpillar were found in Luce County, and were slightly more numerous than in 1959. Some defoliation was reported in Menominee County, although some of it might have been caused by the large aspen tortrix. Defoliation of a widespread extent is not expected in 1960 as there is no evidence at present of an upswing in the population.

Summary of Reports

	1954	1955	1956	1957	1958	1959	1960
Total.....	117	120	111	114	109	119	113
Percent Positive.....	23	17	5	4	0	3	3

Breakdown of 1960 Reports

Heavy defoliation (61-100%).....0.....(0%)
Medium defoliation (21-60%).....0.....(0%)
Light defoliation (1-20%).....3.....(100%)

SPRUCE BUDWORM - Choristoreura fumiferana (Clem.)

Spruce budworm continued at the same endemic levels with no areas of spruce budworm outbreaks in Michigan. Budworm caterpillars could be found in many spruce-fir stands but no noticeable defoliation was reported.

Summary of Reports

	1956	1957	1958	1959	1960
Total.....	40	29	30	25	30
Percent Positive.....	2	3	3	0	0

Breakdown of 1960 Reports

Heavy defoliation (61-100%.....0.....(0%)
Medium defoliation (21-60%).....0.....(0%)
Light defoliation (1-20%).....0.....(0%)

* * *

OTHER IMPORTANT INSECTS

GYPSY MOTH - Porthetria dispar (L.)

The following information on the gypsy moth was received from the Division of Plant Industry, Michigan Department of Agriculture, and is a summary of their work on the gypsy moth during 1960.

The aerial spraying phase of the 1960 gypsy moth erradication program began in May with the spraying of 17,494 acres. Of this, 2,931 acres were in the vicinity of Millet and 5,349 acres near Dimondale, both in Eaton County. The third infestation consisted of 9,214 acres at Duck Lake in Calhoun County.

The trapping phase of the program was carried out in order to determine the effectiveness of past spraying programs and to detect previously unnoticed infestations. The 1960 trapping program was conducted in the following counties:

Calhoun	156	square miles
Clinton	338	" "
Eaton	576	" "
Ingham	448	" "
Ionia	72	" "
Jackson	124	" "
Shiawassee	86	" "
Total	1,800	square miles

This acreage included all previously known infested sites in Michigan.

Eighteen seasonal men were employed to tend the 5,200 traps that were used in trapping 1,152,000 acres. No moths were caught in the traps, and therefore no spraying program is planned for 1961.

This is the second year of negative trapping results since the program started in 1954. The previous negative year was 1957. Two successive negative trapping programs must be experienced before the program can be suspended and therefore in 1961, everything possible will be done to conduct the most thorough and intensive program possible.

PINE ROOT COLLAR WEEVIL - Hylobius radicus Buch.

Tree mortality caused by the pine root collar weevil has increased in intensity and prominence. Scotch pine in windbreaks is especially susceptible and the dead trees are particularly noticeable along roadsides in Crawford, Kalkaska and Wexford counties.

One of the most serious infestations found on state land is in a 23 year old red and jack pine plantation in Kalkaska County. Approximately 20 percent of the trees have been killed. Most of the others are infested and many will die. Unfortunately, there is no control method at present that can be used economically under forest conditions.

The pine root collar weevil is widely distributed and is probably present in all the counties in the northern part of Lower Michigan and the Upper Peninsula.

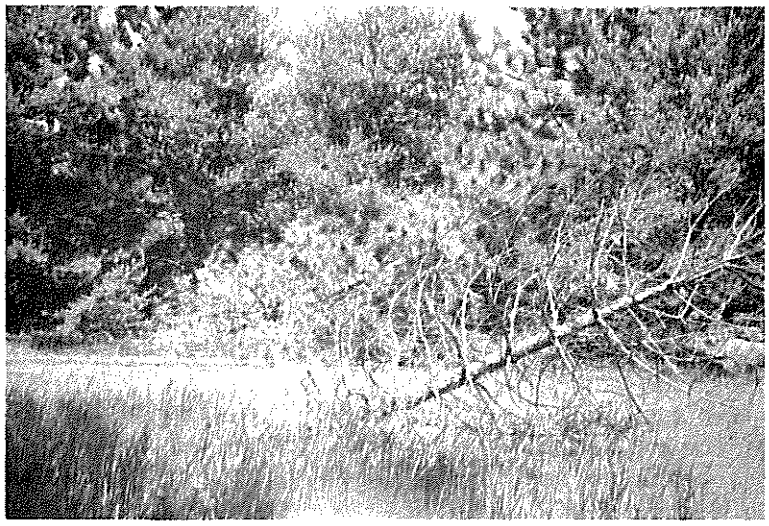


Figure 2.

Red pine killed by the pine root collar weevil and then blown over. Trees planted in 1937.

TWIG PRUNER - Hypermallus villosus (F.)

Twig pruners were especially active this year. While common through most of the range of oak, the heaviest infestations noted were in Clare and Wexford counties. This pest does not cause any damage to forest trees but is mainly of concern to owners of shade trees where the damage is not severe but very obvious, due to the fallen twigs on the ground.

PALES WEEVIL - Hylobius pales (Hbst.)

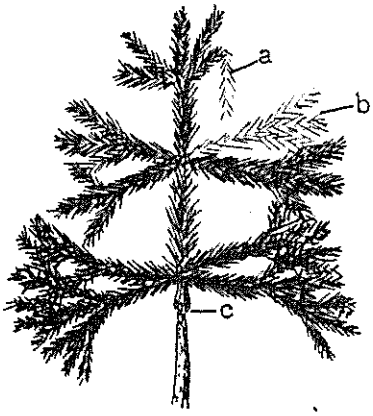
The pales weevil was reported as damaging newly planted Scotch pine in Ottawa County. This is the first report of this pest received by the Pest Detection Program although it has probably been present in Michigan prior to this time.

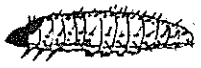
ZIMMERMAN PINE MOTH - Dioryctria zimmermani (Grote)

The Zimmerman pine moth is a complex species causing different kinds of injury to trees of various sizes and species. In Wexford County, the pine moth continues to kill the new growth of red pine in a pole sized stand. There is no evidence of trunk feeding on these trees.

Elsewhere, the important damage is shoot and branch killing, and mining of the cambial region. This latter injury sometimes causes the trees to die. Scotch pine is the primary host for this type of damage. Therefore, in the southern part of Lower Michigan, the Zimmerman pine moth has caused much concern among the Christmas tree growers.

Throughout most of the state, the pine moth can be found feeding in the galls on jack pine caused by the pine-oak or eastern gall rust, Cronartium cerebrum Hedgc. and Long. Feeding appears to be confined to the galls and is of little consequence as the branches beyond the galls would eventually die anyway.





1x

Larva: Reddish-Greenish
Bores in stem at nodes and in new growth
April to July

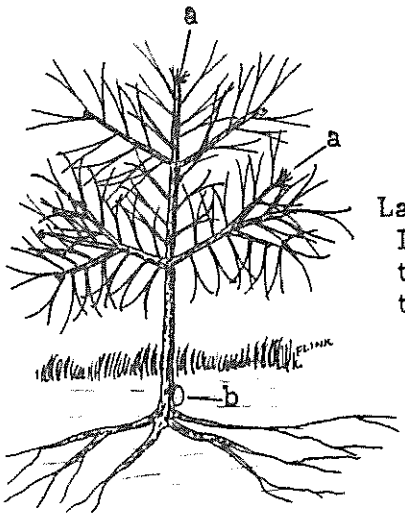
Injury Characteristics:

a. End of new growth killed, center hollowed
b. Branches killed at stem, larval galleries at base
c. Stem injury, pitch masses, stem frequently swollen above

A PINE TIP MOTH - Rhyacionia adana Hein.

A pine tip moth, Rhyacionia adana was first known to be present in Michigan in 1959, although from its widespread distribution, it has undoubtedly been present for many years. It attacks red, jack and Scotch pines, killing the end of the new growth. Damage is confined to young trees, generally those less than three feet tall.

This pest has been found in Gogebic, Dickinson, Schoolcraft, Luce and Mackinac counties in the Upper Peninsula, and Charlevoix, Otsego, Kalkaska, Crawford, Mecosta, Antrim, Missaukee and Cheboygan counties in Lower Michigan.



2½x

Larva: Brown
In needles and tips mid-May to late June

Injury Characteristics:

Only attacks trees 3' high or less

a. Brown hollowed out tip dwarfed needles, no pitch globules
b. Gray, sand covered cocoon attached to root crown, July to April

INTRODUCED PINE SAWFLY - Diprion simile (Htg.)

Introduced pine sawfly larvae were found feeding on white pine in Emmet County. This is a relatively new pest in Michigan and has been only reported previously from Charlevoix, Otsego, Antrim and Kalamazoo counties. The introduced pine sawfly has two generations a year and all stages can be found at certain times during mid-summer. It is a serious defoliator of white, Scotch and jack pines.

SUGAR MAPLE TIMBER BEETLE - Corthylus punctatissumus Zimm.

The sugar maple timber beetle, an ambrosia beetle, was found killing sugar maple and beech reproduction in Antrim County. Maple and beech up to six feet in height were killed. The insect makes its galleries in the base of the trees at the ground line. After the tree is dead, it easily breaks off at the galleries. In most places where the maple reproduction is abundant, this pest is not serious. However, in areas of sparse reproduction, regeneration of the stand could be drastically set back by the loss of young trees.

PITCH BLISTER MOTH - Petrova sp.

The U. S. Forest Service reports the pitch blister moth causing severe damage on over 3,000 acres of jack pine on the Stonington Peninsula in the Rapid River Ranger District of the Upper Michigan National Forest. The trees have been rendered almost worthless.

WALKINGSTICK - Diapheromera femorata (Say)

Walkingstick defoliation was less than in 1958 and much below 1956 and earlier years. The outbreak in Dickinson County covered approximately 800 acres, or about the same area as in 1958. The degree of defoliation was less, being noticeable from the ground but not from the air during an aerial survey. Medium to heavy defoliation in Ogemaw County covered 13,100 acres, in the same general location as that in 1958. The eggs of the walkingstick require two years to hatch and defoliation is noticeable only during even-numbered years in the two outbreak areas in Michigan.

OAK SKELETONIZER - Bucculatrix ainsliella Murt.

Oak leaves in Ogemaw County west of West Branch were skeletonized by the oak skeletonizer. This was in the same area as the walkingstick and the effects of the skeletonizer feeding were masked by the defoliation of the walkingstick.

WHITE PINE SAWFLY - Neodiprion pinetum (Nort.)

Reports on the white pine sawfly indicate that it is becoming an increasingly important pest especially in southwestern Lower Michigan. Heavy defoliation of a few trees was reported in Mackinac County in the Upper Peninsula.

VARIABLE OAK CATERPILLAR - Heterocampa manteo (Dbldy.)

Defoliation of oak by the variable oak caterpillar again occurred in Clyde and Valley townships of Allegan County. Past outbreaks of this and similar defoliators have usually terminated after two or three years, causing little or no damage. It is expected that this will do likewise.

WHITE GRUBS - Phyllophaga spp.

White grubs have caused great losses of newly planted trees on the pine stump plains in parts of Luce and Schoolcraft counties. In 1958, a program was started in which the trees were treated with aldrin applied from sprayers mounted on the planting machines. The roots and surrounding soil were sprayed as the trees were planted. After three growing seasons only 8 percent of the treated trees have been killed by grubs as compared to 56 percent of the trees in untreated check rows. In addition, the growth of the surviving untreated trees was considerably poorer due to root feeding that was heavy enough to injure but not kill the trees.

During the spring and fall 1960 planting season, trees were treated with an aldrin solution as they were planted on 2,095 acres on the Grand Sable State Forest, 20 acres on the Fife Lake State Forest, and 80 acres on the Au Sable State Forest. After one growing season, only 2 percent of the treated trees have been killed by grubs in one check area on the Au Sable State Forest as compared to 26 percent of the untreated trees.

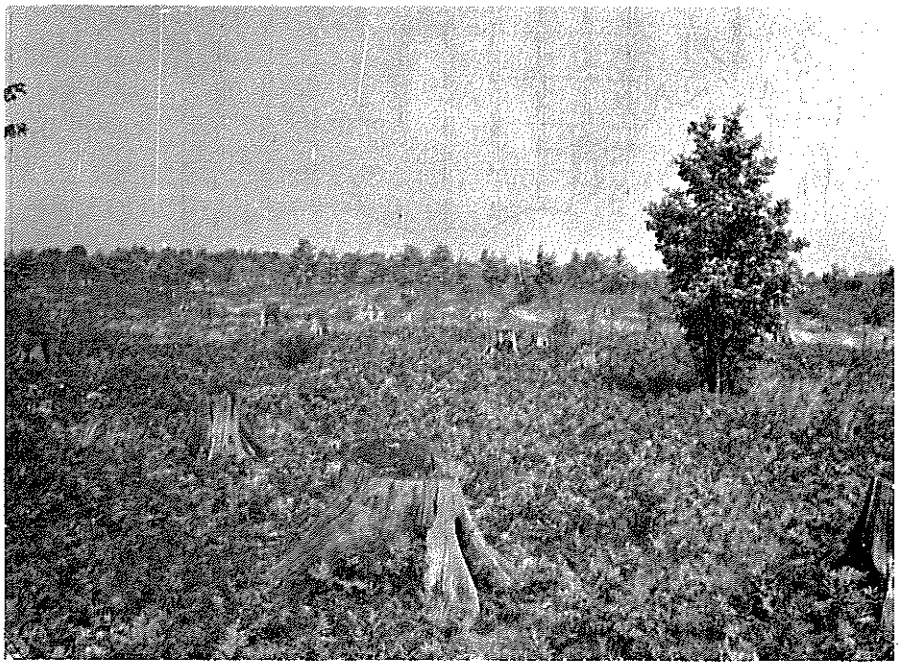


Figure 3.

Pine stump plains typical of area where new plantings suffer heavy losses due to white grubs.

SPRING CANKERWORMS - Palecrita vernata (Peck)

Elm in parts of Manistee, Benzie and Wexford counties were defoliated by spring cankerworms, with complete defoliation occurring in some areas. In the past, top-killing and death of elms has occurred in Otsego County after five years defoliation.

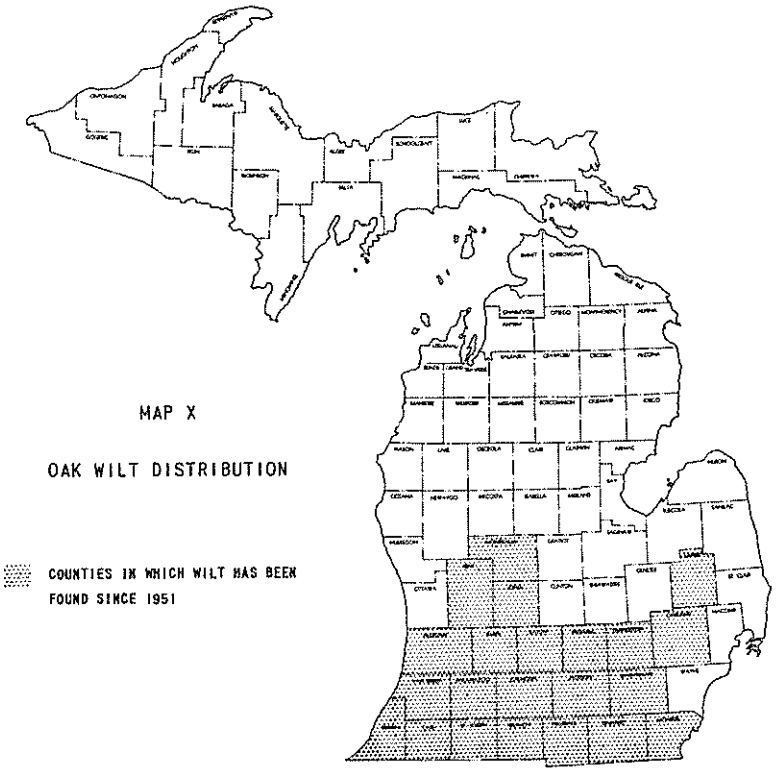
RED PINE SAWFLY - Neodiprion nanulus nanulus Schedl

The U. S. Forest Service reported the red pine sawfly defoliating red pine in Newaygo County.

BALSAM FIR SAWFLY - Neodiprion abietis (Harr.)

Balsam fir along the shore of Lake Michigan, west of Epoufette, in Mackinac County was defoliated by the balsam fir sawfly.

* * *



MAP X

OAK WILT DISTRIBUTION

COUNTIES IN WHICH WILT HAS BEEN FOUND SINCE 1951

MAP XI

DUTCH ELM DISEASE

FARTHEST KNOWN SPREAD OF DUTCH ELM DISEASE BY COUNTY

OAK WILT - Ceratocystis fagacearum (Bretz) Hunt

Since 1951 when oak wilt was first identified in Michigan, a total of 467 infection locations have been discovered. In 1960, eleven of the most active counties were aerially surveyed at one and two mile intervals. Conservation Department planes were used with Conservation Department and State Department of Agriculture observers. Sixty-one locations of oak wilt were found, including 36 new areas, and 25 old areas with new infection. A total of 113 infected trees was found at these sites. This represents a slight increase over the 1959 cases, and is the first increase in several years.

No new areas of oak wilt penetration were found, and it seems to be confining itself more to the previously heavily infected areas in Barry, Cass and St. Joseph counties.

DUTCH ELM DISEASE - Ceratostomella ulmi (Schwarz) Buisman

A cooperative program of survey and control is coordinated by the State Department of Agriculture working with local units of government. This department is responsible for the survey and enforcement phase of the program, and the municipalities conduct the necessary sanitation and spraying. Laboratory facilities for diagnosing Dutch elm disease and oak wilt are maintained at Michigan State University; the laboratory is permanently housed in the new State Department of Agriculture Chemical Control Laboratories Building.

The following statement regarding the 1960 Dutch elm disease program was prepared by the Division of Plant Industry of the State Department of Agriculture.

"Generally speaking, Dutch elm disease has spread throughout the State of Michigan until it now encompasses the entire southern half of the Lower Peninsula. No control activities were conducted outside of municipalities, and those that have conducted a complete spray and sanitation program for a period of years are still showing a reduction in the incidence of this disease. Some communities have abandoned the complete control program while others have adopted it. It would seem now that these measures are necessary in order to preserve those elms that communities consider to be of high aesthetic value. With the ever present reservoir of diseased trees in rural Michigan, reinfection will always be a problem.

"During the past summer the Department of Agriculture sampled 11,136 trees of which 8,961 were found to be infected and therefore condemned. Six thousand three hundred twenty-six dead trees and 461 woodpiles were also condemned."

In addition to the sanitation and control programs carried on by municipalities, the Parks Division of the Conservation Department has had a Dutch elm disease control program in its southern Michigan state parks and recreation areas since 1953. Special funds for this work were first appropriated in 1956.

The survey program in the sixteen recreation areas and state parks is

carried on by the regular park personnel in each area. Samples were taken from 167 suspected trees. The 100 trees verified as being infected were removed.

Sanitation is carried on in the most important and developed parks and recreation areas by a private contractor. In 1960, 23 trees were removed and the dead branches were trimmed off of 8,468 trees. Spraying of 15,585 trees was accomplished during the fall of 1959 and spring of 1960 to protect trees from this disease in these areas.

WHITE PINE BLISTER RUST - Cronartium ribicola Fischer

A detailed report of the white pine blister rust situation and control program is prepared annually by the Area Leader for this cooperative federal-state project. A brief summary of this report for 1960 follows:

White pine bliser rust surveys were considerably increased and control operations were decreased in Michigan in 1960. Mappling was completed on approximately 48,000 acres of control area containing about 25,000 acres of white pine. These surveys were made during the fall, winter, and early spring seasons by regular assigned personnel. White pine continues to regenerate quite satisfactorily on the lighter soils. Planting of white pine is also on the increase.

Aerial surveys by helicopter and fixed wing planes have been a great help in locating potential white pine stands. Helicopters and flying boats were donated by the Traverse City Coast Guard base and fixed wing planes were rented from the Department of Conservation. Only a part of the east end of the Upper Peninsula and six partly forested counties in the Lower Peninsula remain to be aerially checked.

Ribes eradication started during mid-May and continued to September 15. Corrections Department Conservation camps furnished the bulk of labor for work on State and private lands. Consumers Power Company contracted ribes eradication on their lands. There were a few other private owners who provided labor for ribes eradication, mainly in the Upper Peninsula.

During the summer season 15,247 acres of pine were protected by destroying 465,000 ribes on 30,000 acres of control area. This work was done with an expenditure of 3,075 man days.

At the present time there are on record about 510,000 acres of white pine which have been mapped and determined to be adequately stocked. To protect this acreage of pine, ribes eradication is necessary on 1,350,000 acres of control area. By the end of 1960, 87 percent of the control area had received initial eradication and 48 percent had been placed on maintenance. Only 41 percent of the control area in private ownership is on maintenance. Of the Non-Federal ownership, mainly State, 60 percent is on maintenance.

Antibiotics were used to kill cankers on a test basis. Results of earlier treatments look favorable. Antibiotics from two separate labora-

tories were used during the year: Actidione from the Upjohn Company and phytoactin from Pabst Laboratories. An aerial application with phytoactin was applied on three infected plantations in Charlevoix County in cooperation with the Forestry Division and Pabst Laboratory. A total of 18 acres were sprayed with the antibiotic in water solution. Results will be carefully checked in the summer of 1961.

Heavy fruiting of cankers started in southern Michigan near the end of April. Peak production of aecia spores occurred in northern Michigan about the middle of May. Ribes infection was not as abundant generally as was noted last year. Heavy ribes infection was spotty. The rather dry fall should not have been unfavorable for spread of rust to pine.

PINE-OAK, or EASTERN GALL RUST

Galls caused by the pine-oak or eastern gall rust are usually common in most jack pine plantations. However, extremely heavy infections were found in Otsego County where some plantations had over 90 percent of the trees infected, half of which were on the main stem. In most cases where the gall is on the main stem, the tree above the gall will die. This is particularly serious where the trees are infected before planting and the galls are close to the ground line. Losses have occurred and will continue to occur until a control method is found for preventing the dissemination of infected nursery stock.

BACTERIAL TWIG BLIGHT OF WILLOW - Pseudomonas saliciperda

Willow trees in a roadside park along U. S. 27 north of Gaylord showed signs of leaf and twig killing, and the Department of Botany and Plant Pathology identified the causal agent as bacterial twig blight of willow. This disease can become serious, causing complete defoliation and death of the trees.

* * *

OTHER CONDITIONS

WEATHER

Weather in various forms had a considerable influence on Michigan's forests in 1960. A prolonged soil moisture deficit that started in 1955 was alleviated in the fall of 1959 and spring of 1960, when ground water levels returned to normal and in some places above normal levels.

One of the most significant results of the raised water table was the cessation of tree and branch mortality in several pine plantations. During the past several years unexplained branch and tree mortality has occurred. It has

not been possible to single out the causes of this plantation decline, although many factors have been contributory, such as Armillarea root rot, bark beetles, Saratoga spittlebugs, snow breakage, etc., along with the lowered water table.

Wind - In late August a storm with wind of extremely high velocity crossed Michigan from Traverse City to Bay City, uprooting trees in its path. There is no estimate available of the number of trees damaged or killed. In addition to those obviously injured, the effects of the loosening and breaking of roots may not show up for several years. Poor growth and increased susceptibility to root rots and other diseases may result.

Frost - Severe frosting of the new growth of red and jack pine occurred over most of the pine plains area of Schoolcraft and Alger counties. A temperature of 26° was recorded during the early morning of July 1 in Shingleton. The temperature was undoubtedly lower in frost pockets and many open areas where the air was still. Unfortunately, the total effects of the damage caused cannot be assessed until next year or possibly longer, at which time the amount of height loss and deformity can be evaluated. Jack pine trees were not noticeably affected. The leaves of maple sprouts turned red and dropped prematurely.

Figure 4.

New growth of red pine damaged by frost July 1, 1960.

Hail - Hail, accompanied by high winds, was responsible for seriously damaging trees on over 300 acres in Dickinson County near Ralph. Red pine, jack pine, and aspen up to 8 inches d.b.h. were killed. The bark was completely stripped off the top of some of the branches. Alder was killed back to the ground and all species of trees were injured.

Drought - Precipitation during the fall of 1959 and spring of 1960 alleviated the severe drought conditions in much of the state. However, effects of the soil moisture deficit of recent years were still showing up in 1960. Jack pine in northwestern Ogemaw County and Crawford and Roscommon counties continued to die. These trees, weakened by lack of water, were attacked by bark beetles and Armillarea mellea root rot. Both of these agents are secondary organisms and as the remaining trees regain their normal health, the tree mortality should drop.

In certain plantations in northern Iron and eastern Alger counties, branch and tree mortality has occurred for several years during the period of soil moisture deficiency. Little or no new dead branches were observed in these areas in 1960 and therefore it is presumed that soil moisture was the important factor.

Winterburn - Winterburn or winter drying of coniferous needles is a common occurrence that is found to some extent after most winters. However, conditions were particularly severe during the winter of 1959-60, and winterburn was noticeable in early 1960 in many places in Lower Michigan. Although roadside and windbreak trees are most susceptible because of their exposed situation, considerable browning of the old needles also occurred in plantations. This condition is seldom serious but causes concern among the tree owners.

DYING MAPLE BRANCHES

Branches dying on maple trees caused much concern in many communities, particularly those in Kalkaska, Wexford, Crawford and Clare counties. The injury was characterized by a gradual dying back of the branches. The leaves wilted, turned brown and fell to the ground.

Pathological studies by the Department of Botany and Plant Pathology, Michigan State University, disclosed a fungus, Stagonosporium pyriforme, sporulating on the dead parts of some of the trees. This fungus is usually considered to be saphrophytic, growing only in dead bark, but it may be weakly parasitic, causing the die-back on trees of low vigor.

Although the dead branches were more prevalent in trees in communities, many trees in forest areas showed the same symptoms. The seriousness of this condition is not known at present.

It is felt that the branch dying is not due to one single agent but to a combination of many factors, including soil moisture deficiency, compaction of soil around the roots, frosts, and weak pathogens. As far as could be determined, insects are not involved.

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SUMMARY

Since 1950 the Michigan Forest Pest Detection Program has provided information on: (1) the presence or absence of the important forest pests in the state; (2) population trends of the pests; and (3) the areas where infestations necessitate more detailed surveys and possible control. Most of this information is received on the 1,749 observation reports submitted by foresters. Additional information is gained through letters, postal cards, and special surveyes. Information on Dutch elm disease, oak wilt, gypsy moth, and white pine blister rust is provided by the Michigan Department of Agriculture and U. S. Forest Service.

Jack pine budworm populations remained at a low level in Lower Michigan and greatly increased in the Upper Peninsula, particularly in Chippewa, Marquette, and Baraga counties.

Infestation of the white pine weevil continued at a high level, seriously deforming its host trees in most parts of the state.

A general decline in European pine shoot moth damage was noted in 1958 and 1959 and continued at this lowered level in 1960.

A sharp decline of the red-headed pine sawfly occurred in the northeastern section of Lower Michigan. In the northwestern section, infestations remained at a higher level, necessitating the spraying of 3,129 acres of state land to protect the red and jack pine plantations. It is expected that only the northwestern section will have high enough populations to warrant a control program in 1961.

Damage due to the Saratoga spittlebug was less prominent in 1960 than it had been in 1959. This reflected the lower population that was present in 1959.

The overall populations of the anomala beetle continued to remain at a low level, as they have since 1958.

Larch sawfly defoliation tapered off somewhat in some areas of the Upper Peninsula, particularly the western section.

Forest tent caterpillar, and spruce budworm populations remained at a low endemic level.

Walkingstick defoliation of oak was less than it had been in former years with about 13,000 acres defoliated in Ogemaw County.

An aerial spray program to control the gypsy moth was used on 17,494 acres by the Michigan Department of Agriculture. Their trapping program failed to catch any male moths, thus indicating that no spraying will be necessary in 1961

The Pales weevil, pine root collar weevil, pine sawflies, Zimmerman pine moth and other insects caused damage or defoliation of local concern.

A slight increase in new oak wilt locations were found in 1960 over those found in 1959. Sixty-one locations were found, 36 of which were new infections.

Dutch elm disease is now spread through most of the southern half of the Lower Peninsula. Communities carrying on a complete spray and sanitation program are showing a reduction in incidence of the disease. The spraying and sanitation program in the most important and developed protective areas of the state parks and recreation areas in the southern part of the Lower Peninsula is continuing.

Blister rust control work to protect 25,000 acres of white pine was done on 48,000 acres by destroying the ribes plants.

Weather in various forms had a considerable influence on the forests in 1960. A prolonged soil moisture deficit that started in 1955 was alleviated in the fall of 1959 and spring of 1960. One result of the raised water table was the cessation of tree and branch mortality in several pine plantations.

Winds of high velocity broke and uprooted many trees in Lower Michigan, a summer frost killed back the new growth of red pine in parts of the Upper Peninsula, and hail killed red and jack pines and aspen on 300 acres in Dickinson County.

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